Simple Harmonic Motion

2004

C3. A piston connected to a water wheel oscillates about a point O with simple harmonic motion of period 8π seconds and maximum acceleration $0{\cdot}25\ \text{m s}^{-2}$.

(a) Calculate the amplitude of the motion. **3**

(b) Calculate the positions, relative to O, of the piston when it is moving with half its maximum speed. **4**

2005 SP

5. A particle performs simple harmonic motion in a straight line, between points A and B, with period 0·6 seconds. Initially it was projected from C, the midpoint of AB, with speed $\frac{\pi}{5}\ \text{m s}^{-1}$ towards B.

Calculate

(a) the length of AB, and **3**

(b) the time taken by the particle to move directly from C to D, the midpoint of CB. **2**

2005

A3. A particle executes simple harmonic motion about a point O. The magnitude of the maximum acceleration is $1\ \text{m s}^{-2}$ and the maximum speed is $4\ \text{m s}^{-1}$.

Calculate the period of the motion. **4**

2006

A2. A piston oscillates about the point O with simple harmonic motion of amplitude 0·25 m.

Calculate the distance of the piston from O when its speed is half its maximum speed. **5**

2007

A2. A piston in a machine moves with simple harmonic motion about a point O. The period of the motion is 4π seconds. When the piston is 0·2 m from O its speed is $0{\cdot}8\ \text{m s}^{-1}$.

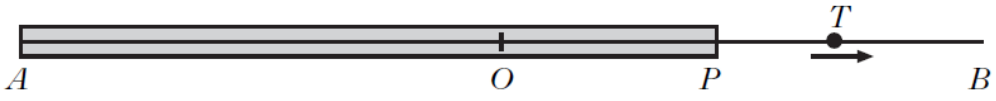
Calculate the amplitude of the motion. **4**

2008

A8. In a fairground game, a small target T executes simple harmonic motion about a point O with extreme points A and B. When the target is 1 metre from O, its speed is $\frac{\pi}{\sqrt{3}}\ \text{m s}^{-1}$ and when it is $\sqrt{3}$ metres from O its speed is $\frac{\pi}{3}\ \text{m s}^{-1}$.

(a) Show that the amplitude of the motion is 2 metres and calculate the period of the oscillation. **5**

(b) A player has to shoot at the target, but it is only visible to the player when it is to the right of the point P as shown in the diagram.



Given that the target takes 0·75 seconds to move from P to B, calculate the distance PB. **5**

2009

A1. A particle is projected from O at time $t = 0$ and performs simple harmonic motion with O as the centre of the oscillation. The amplitude is 10 cm and the speed of projection is $10\ \text{m s}^{-1}$. Calculate:

(a) the period of the oscillation; **2**

(b) the speed of the particle when it is 5 cm from O. **2**

2011	**A5.** A charged particle oscillates with simple harmonic motion of amplitude 0·05 metres between two parallel plates in an electric field. The speed of the particle, v metres per second, satisfies the differential equation $$v\frac{dv}{dx} = -\omega^2 x,$$ where x metres is the displacement from a fixed point and ω is a constant. Obtain an expression for v^2 in terms of x and ω. **3** Given that the period of the oscillation is $1{\cdot}5 \times 10^{-4}$ seconds, calculate the maximum speed of the particle. **3**
2014	**A2.** An object oscillates on the x-axis about the origin, O, with simple harmonic motion. The period of the oscillation is $\frac{14\pi}{5}$ seconds, and when the object is at point K, 1·2 metres from the origin, it is moving away from the origin with a velocity of $2{\cdot}5\ \text{m s}^{-1}$. Find the amplitude of the motion and the time it takes for the particle to travel from O to K. **4**
2016 SP	**6.** An object moves horizontally along the x-axis with simple harmonic motion about a point O. The period of the oscillation is 12 seconds. It is released from its extreme position A, a distance of 3 metres from O. Find the first time the particle will be a distance of 4 metres from A. **4**
2016	**5.** The tip of a saw oscillates with simple harmonic motion. • When the tip is 5 mm from its centre of motion it has a velocity of $2\ \text{m s}^{-1}$. • When it is 7 mm from the centre it has a velocity of $1\ \text{m s}^{-1}$. Calculate the amplitude of the motion and find the number of oscillations in one second. **5**